View metadata, citation and similar papers at core.ac.uk
brought to you by CORE
provided by International Institute for Science, Technology and Education (IISTE): E-Journals

Journal of Natural Sciences Research
ISSN 2224-3186 (Paper) ISSN 2225-0921 (Online)
Vol.7, No.1, 2017
www.iiste.org

Prevalence of Lungworm Infection of Small Ruminants in Assela and its Surroundings

Hubado Hussien Seifudin Kasim Sisay Shibeshi Mukarim Abdurahaman
School of Veterinary Medicine, College of Agriculture and Veterinary Medicine (JUCAVM), Jimma University, PO Box 307, Jimma Town, Ethiopia

Abstract
A cross-sectional study of lungworm infection was carried out from October 2009 to March 2010 with the aim of determining the prevalence of lungworm infection of small ruminants, identifying the species of the respiratory helminthes and to investigate some risk factors associated with lungworms of small ruminants in study area. Faecal examination was conducted by using modified Baermann technique on 384 animals; furthermore, postmortem examination was conducted on 84 animals. An overall prevalence of 59.9% and 63.1% was found by faecal and postmortem examinations, respectively. Prevalence of 71.9% and 57.5% was recorded in goats and sheep, and there was statistically significant difference ($\chi2 = 4.588$, $p < 0.05$) between the prevalence's. There was also statistically significant difference between prevalence of lungworms in female (64.2%) and male (51.1%) animals ($\chi2 = 5.7147$, $P < 0.05$). Higher prevalence (67.2%) was observed in animals of less than or equal to one year of age than the prevalence (56%) in animals of greater than one year of age, and the difference between the prevalence was statistically significant ($\chi2 = 4.527$, $P < 0.05$). Prevalence of 76.8%, 51.8% and 48.5% was recorded in animals of poor body condition, medium body condition and good body condition, respectively; the difference between the prevalence was statistically significant ($\chi2 = 26.957$, $P < 0.05$). Higher level of prevalence of lungworms (71.4%) was recorded in animals which had respiratory symptom than the prevalence (52.9%) in animals which were apparently healthy; there was statistically significant difference between the prevalence ($\chi2 = 13.188$, $P < 0.05$). Three species of lungworms including *Dictyocaulus filaria*, *Protostrongylus rufescens* and *Muelerius capillaries* were detected, and *Dictyocaulus filaria* was isolated more frequently both by faecal and postmortem examinations. In conclusion, small ruminants are at risk due to lungworms in the study area; therefore farmers should be informed regarding the risk factors and to practice strategic deworming.
Keywords: Assela, *Dictyocaulus filaria, Muellerius capillaris, Protostrongylus rufescens*, Lungworms, Small ruminant, Ethiopia.

1. INTRODUCTION

Ethiopia has over 18 million head of sheep and 24 million goats (PFE, 2004). However, in spite of the presence of this huge number of small ruminants, sheep and goats, the country fails to optimally utilize the resource, as the sector is suffering from lower productivity (Teshale *et al*., 2006). This is partly because of small ruminant production is constrained by different prevalent diseases, poor feeding and poor management practices (Getachew, 1995). Morbidity and mortality are high in the traditional agro-pastoral production systems (FAO, 1983).

Helminthes parasites of ruminants are ubiquitous, with many tropical and subtropical environments of the world providing nearly perfect conditions for their survival and development (Hansen, 1994). In sub-Saharan Africa, helminthosis is of considerable significance in a wide range of ago-climate zones and constitutes one of the most important constraints to small ruminant production (ILCA, 1991). Clinical signs caused by helminthes in infected animals can be less obvious than signs of other livestock diseases. Partly for this reason, infections with helminth parasites are among the most neglected areas of veterinary care in much of the developing world. It has however been established that high prevalence rates of the infection with less obvious sign associate with poor production and unthriftness (Hansen, 1994).

The production loss due to helminths is associated with direct consequences of clinical and subclinical infections resulting in low productivity due to stunted growth, reduced weight gain, poor feed utilization or loss due to mortality or indirect loss associated with cost of treatment and control measures (Ayalew, 1995; Desalegn, 1999). In the Ethiopian high lands including Arsi zone of Oromia national regional state, infection with lungworms are the common cause of morbidity and mortality of small ruminants (FAO, 1983).

Several studies have been done concerning the prevalence and economic significance of lungworm infection of small ruminants in Ethiopia and indicated varied infection prevalence (Tsegaye, 1985; Uqbarzghi, 1990; Alemu *et al*., 2006, Biru, 2009). Paulos (2000) reported the presence of lungworms of small ruminants with infection prevalence of 52.54% in his study in Chilalo area of Arsi zone of Oromia national regional state. However, information on the current status of lungworms of small ruminants in Assela and its surroundings is lacking. Therefore, this cross-sectional study was carried out with objectives; to determine the prevalence of lungworm infection, to identify the species of the lungworms involved, and to find out associated risk factors of

lungworms in small ruminants in Assela and its surroundings.

2. MATERIALS AND METHODS

2.1. Study area

The study was conducted in Assela and its surroundings, Tiyo Woreda, Arsi zone. Arsi zone is located at 6º 15´-8º49´N and 38º41´- 40º41´ E, 175kms south east of Addis Ababa. The altitude of the study area ranges from 1780-3100 meters above sea level and temperature ranging from 5-28ºC with average annual rainfall of 1200mm. Arsi zone has topography high land escarpment and low land areas, the high land found centrally and the low lands dominate at the periphery. The study area is covered by scattered trees and bushes to dense shrubs, grass dominating in both cases (APEDO, 2008).

Livestock is the major agricultural resource in Arsi zone and there are 2249479 cattle, 928603 sheep, 467221 goats, 154701 donkeys, 197365 horses, and 36016 camels (APEDO, 2007). Animals are grazing being kept together.

From the study area Lelocheka, Dosha and Konecha with altitudes of 1850, 2300 and 2800 meters above sea level, respectively (TWRAD, 2008) were the sampling sites.

2.2. Study population

The study populations were sheep and goats in Assela and its surroundings all reared under extensive management system. These animals are maintained in small house hold flocks of mixed age for subsistence and for sale. The number of goats is decreasing with increasing altitude while that of sheep increase markedly and goats contribute smaller proportion.

2.3. Study design

The study was cross-sectional study involving 384 small ruminants (320 sheep and 64 goats) obtained from three sites of Assela and its suroundings. Three sites including Lelocheka, Dosha and Konecha were selected from the study area. The variable of interest considered as an output variable versus risk factors during the study was faecal status for larvae or adult parasites in slaughtered animals for small ruminant lungworms. The explanatory variables considered were the species differnce, age, sex, altitude, body condition and season of the year.

Ages of studied animals were also estimated according to Steel (1996). Based on their age, animals grouped in to two categories; the first group includes less than one year of age, lambs and kids, while the cond group includes sheep and goats greater than one year of age.

Body condition score was made according to Cooper and Thomas (1985). Poor body condition score was given to animals that were extremely thin to those with smooth and less prominent spinous process, transverse process in which finger can be pushed and those having moderate depth of loin muscle. Medium body condition score was given for sheep and goats in which the spinous process only stickup very slightly; smooth, not much rounded and fairly covered transverse process and those having fair loin muscle and not fat. Sheep and goats which were very smooth, clearly round, covered transverse process, faty and developed loin considered good body condition.

2.4. Sample size determination

The sample size required for this study was determined based on sample size determination in random sampling for infinite population using expected prevalence of small ruminant lungworms at 5% desired absolute precision according to (Thrusfield, 2005) as follows:

$$n = \frac{1.96^2 \, pexp \, (1-pexp)}{d^2}$$

Where:

n= required sample size
pexp = recorded previous prevalence = 52.54%
d = desired absolute precision = 5%

In Assela, pulmonary helmenthiosis was reported with prevalence of 52.54% (Paulos, 2000). The sample size of the study was therefore calculated using 52.54% expected prevalence and 5% absolute precision at 95% confidence level. As estimated by the formula, 384 sheep and goats were considered for the study. In addition, 84 animals (63 sheep and 21 goats) were examined at post mortem for the presence of adult parasites.

2.5. Sample collection

Sheep and goats above four months of age were randomly selected and faecal samples were collected directly from the rectum in screw capped universal bottles. Similarly, fresh faecal samples were colleted from the rectum of selected sheep and goats before they are going to be slaughtered at Assela municipal abattoir. The date of sampling, study site, species of the animals, sex, age, body condition and overt respiratory signs were recorded.

Collected samples were packed in an ice pox and transported to Assela regional veterinary laboratory for detection of first stage larvae of lungworms.

For postmortem examination, animals slaughtered at Assela municipal abattoir which were selected for faecal examination were examined for the detection and identification of adult lungworms parasites. Likewise the species of the animal, sex, and body condition were recorded.

2.6. Diagnosis

2.6.1. Laboratory diagnosis

In the laboratory following conventional method of Baermann techniques for defection of lungworm larvae, 25 gram of fresh faeces was weighed from each sample for the extraction of L_1 larvae and enclosed in gauze fixed on to a string rod and submerged in a clean glass tube filled with warm water. The whole apparatus left for 2 to 3 hours, and then the sediment was examined under the low power of the microscope after siphoning off the supernatant. When positive, a drop of 1% iodine solution was used to immobilize the larvae for identification of species. Otherwise it was registered negative for lungworm infection (Fraser, 1991; Urquhart, *et al.,* 1994). In both cases, the result was recorded corresponding to the specific animal.

2.6.2. Post mortem examination

Small ruminants slaughtered at Assela municipality abattoir were examined during the study period. Lungs from slaughtered animals were palpated for the presence of protostronglidae nodules. If nodules present they are trimmed off and worms extracted from the tissue by gentle compressing a small non-calcified nodules or apart of large nodules between two glass slides and then carefully teasing the worm away from the tissue. Air passage where opened starting from the trachea down to the small bronchi with fine blunt pointed scissor to detect the presence of adult dictyocauludae (Kassai, 1999; Schinder, 2000).

2.7. Identification

The larvae of *D.filarial* diffentiated form *P. rufescens* and *M. capillaris* by having characteristic cuticular knob at the anterior extremity, large size and straight tail (Anne and Garry, 2006; Radostits, *et al*., 2007). The larvae of *P. rufescens* and *M. capillaris* differentiated from *D. filaria* by their small size and absence of anterior cuticuar knob, while *P. rufescens* and *M. capillaris* are differentiated from each other by their characteristic features, at the tip of their tail. *Protostrongylus rufescens* has a wavey out line at the tip of its tail, but devoid of dorsal spine, on the other hand *M. capillaris* has an undulating tip and a dorsal spine (Urquhart *et al.,* 1996; Radostits, *et al*., 2000; Anne and Garry, 2006).

At postmortem examination, the adult parasites of *D. filaria* are whitish in color with relatively long bursa, speculum (dark brown in color) and foot shaped measuring above 0.4-0.64 mm in length and the vulva of the female found posterior (Dunn, 1978). *Protostrongylus rufescens* occurs in the small bronchioles of the animals. Both female and male are flair form and reddish in color while different in their length (the male measures 16 to 28 mm and female 25 to 35 mm in length) (Soulsby, 1982). The female worm identified by their conical tail and terminal in small point and the vulva open near the anus (Dunn, 1978; Soulby, 1982). *Mullerius capillaris* occurs in alveolar ducts, small bronchiol and lung parenchyma of the animals (Radostits *et al*., 2000). Males measure 11-26mm in length and female measure 18-30mm having spirally wived. The female has sub-terminal vulva small cuticular thicking dark border (Soulsby, 1982).

2.8. Data analysis

The data entered and managed in MS Excel work sheet. The analysis was conducted using Stata version 7 (Stata Corporation, 2000). Prevalence of lungworm at animal level was expressed as percentage, with 95% confidence interval (CI) by dividing the total number of animals positive to lungworms to the total number of animals examined. An animal was considered positive for lungworms if it was positive either through faecal or postmortem examinations or positive in both techniques.

The significance of differences between the prevalence of lungworms was determined using Chi-square test. The explanatory variables (sex, age, altitude, body condition) were considered as risk factors to see their association with the level of prevalence.

3. RESULTS ANDDISCUSSION

3.1. Coprological examination

Of the total of 384 small ruminants (320 sheep and 64 goats) examined 59.9 % (230 of 384) were positive for larvae of lungworms. Lungworm infestation was observed in the three study sites Lelocheka, Dosha and Konecha; the lowest (49.2%) and the highest (68.8%) prevalences were observed in Lelocheka and Konecha (Table 1), respectively. There was statistically significant difference between the prevalences of lungworms in animals of the different study sites ($\chi 2 = 10.4294$, $P < 0.05$).

Table 1: Prevalences of smallruminant lungworms in the different study sites

Study sites	Number of animals	
	Animals examined	Positive (%)
Lelocheka	128	63 (49.2)
Dosha	128	79 (61.7)
Konecha	128	88 (68.8)
Total	384	230 (59.9)

$\chi 2 = 10.4294$, $P = 0.005$

When prevalence was compared between sheep and goats, higher prevalence (71.9%) was observed in goats (Table 2), and there was statistically significant difference between the prevalences of lungworms in sheep and goats ($\chi 2 = 4.588$, $p < 0.05$).

Different level of prevalence, 64.17% (163 of 254) and 51.54% (67 of 130) observed in female and male animals, respectively (Table 2). There was statistically significant difference ($\chi 2 = 5.7147$, $p < 0.05$) between the prevalences of lungworms in female and male animals.

Table 2: Prevalence of lungworm infection on the basis of species, sex and age

	Species (n = 384)		Sex (n = 384)		Age (n = 384)	
	Sheep	Goats	Male	Female	≤ 1 year	> 1year
Total examined	320	64	130	254	134	250
Positive	184	46	67	163	90	140
Prevalence (%)	57.5	71.9	51.1	64.2	67.2	56
$\chi 2$	4.588		5.7147		4.527	
P value	0.032		0.017		0.033	

When prevalences of lungworms observed between animals less than or equal to one year of age and animals of greater than one year of age, higher prevalence (67.2%) was observed in the age group of less than or equal to one year of age (Table 2). The difference between the prevalences of lungworms in the two age groups was statistically significant ($\chi 2 = 4.527$, $P < 0.05$).

The highest prevalence of lungworms (76.8%) was observed in poor body conditioned animals when lungworm infestation was compared between the different body condition animals (Table 3). There was statistically highly significant difeerence between the prevalences of lungworms in small ruminants of different body condition ($\chi 2 = 26.957$, $P < 0.05$).

Table 3: Prevalence of lung worm infection in small ruminants' in relation to body condition

Body conditions	Number of animals	
	Animals examined	Positive (%)
Poor	142	109 (76.8)
Medium	110	57 (51.8)
Good	132	64 (48.5)
Total	384	230 (59.9)

$\chi 2 = 26.957$, $P = 0.000$

Prevalence of lungworms was observed between animals which showed symptoms of respiratory signs usually coghing and nasal discharge and animals which were aparently healthy, higher prevalence (71.4%) was recorded in animals showing respiratory symptoms (Table 4). The difference between the prevalences of lungworms in animals showing respiratory signs and in animals which were aparently healthy was statistically highly significant ($\chi 2 = 13.188$, $P < 0.05$).

Table 4: Prevalence of lungworm infection between animals with respiratory signs and animals which were apparently healthy

Respiratory symptom	Number of animals	
	Animals examined	Positive (%)
Animals show symptom	147	105 (71.4)
Apparently healthy	237	125 (52.7)
Total	384	230 (59.9)

$\chi 2 = 13.188$, $P = 0.000$

Prevalence of lungworms was observed in the different months of the study period. Among the study months, the highest prevalence (68.8%) was observed in December (Figure 1). The difference between the prevalences of lungworms in the different months of the study period showed statistically significant difference ($\chi 2 = 9.238$, $P < 0.05$).

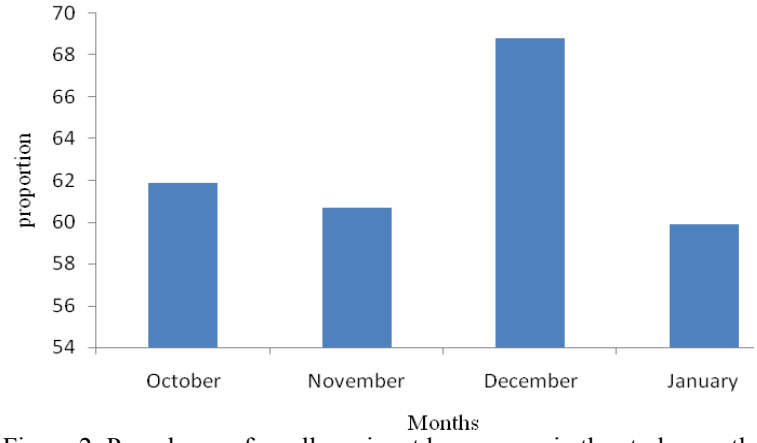

Figure 2: Prevalence of small ruminant lungworms in the study months

3.2. Postmortem examination

Lungs from 84 animals (63 sheep and 21 goats) slaughtered at Assela municipal abattoir examined for the presence of adult lungworms; 63.1% (53 of 84) of the slaughtered animals were positive for adult lungworm parasites (Table 5). Higher prevalence of adult worms was observed in goats (66.7%) than in sheep. However, there was no statistically significance difference between the prevalence of adult lungworms ($\chi 2 = 0.1703$, $P > 0.05$) in sheep and goats.

Table 5: Prevalence of adult lungworms in sheep and goats slaughtered at Assela municipal abattoir

Species	Number of animals	
	Examined animals	Positive (%)
Sheep	63	39 (62)
Goats	21	14 (66.7)
Total	84	53 (63.1)

$\chi 2 = 0.1703$, P = 0.982

3.3. Species of worms identified by faecal and postmortem examination

Three species of lungworms including *D. filaria, M. capillaries* and *P. rufescens* were identified. Of the different identified species, *D. filaria* was isolated more frequently both by faecal and postmortem examinations followed by *P. rufescens*. Each of the identified species of lungworms was more frequently detected from goats compared to sheep (Table 6).

Table 6: Species of lungworms identified by coprological and postmortem examination

Type of examination	Animals examined	Species of worm identified			Mixed	Total (%)
		D. filaria (%)	M. capillaris (%)	P. rufescens (%)		
Faecal						
Sheep	320	96 (30)	20 (6.3)	43 (13.4)	25 (7.8)	184 (57.5)
Goats	64	21 (32.8)	8 (12.5)	13 (20.3)	4 (6.3)	46 (71.90)
Total	384	117(30.5)	28 (7.3)	56 (14.6)	29 (7.6)	230 (59.9)
Postmortem						
Sheep	63	19 (30.2)	9 (14.3)	11 (17.5)	-	39 (62)
Goats	21	7 (33.3)	3 (14.3)	4 (19)	-	14 (66.7)
Total	84	26 (31)	12 (14.3)	15 (17.9)	-	53 (63.1)

The study indicates an overall lungworm infection of 59.9% in Assela and its suroundings. This overall infection prevalence is in agreement with previous work of Paulos (2000) and Alemu *et al*. (2006) who reported infection prevalence of small ruminant lungworms with prevalences 52.54% and 53.6% from their study in Chilalo area of Arsi and in northeastern Ethiopia. However, it was higher than the work of Tefera (1993) who reported 15.47% infection prevalence of small ruminant lungworms in Dessie and Kombolcha. The difference in the prevalence of the current study with that of other previous studies might be associated the method followed in detection of the larvae and/or due to the difference in the study area which favors the survival of the larvae of the lungworms or intermediate host especially for *P. rufescens.*

Prevalence of lungworm infection in the different study sites was compared; the highest prevalence (68.8%) was observed in Konecha followed by Dosha and the lowest in Lelocheka. The reason might be associated with the time of sampling or due to variation in climatic variability in the study areas. Samples were

not collected at the same month from the study area.

Survival and development of lungworm larvae is favored by low moisture content and high humidity; for instance infective larvae on pasture is minimum during the summer months but it reaches peak levels during the cooler autumn (Ayalew, 1973). Such conditions are obtained after long rainy season (September to November) at high altitude areas.

High level of prevalence (71.9%) was observed in goats compared to sheep (57.5%). Similarly Alemu *et al,* (2006) and Biru (2009) reported that goats were more susceptible to lungworm infection. This might be associted with the level of immunity; Sheep predominantly graze; pickup more parasites so have higher acquired resistance than goats which mostly consume browse. Goats with their browsing behavior consume uncontaminated matter with parasite larvae, so being less exposed to infective larvae, and may therefore have lower acquired resistance and higher prevalence than sheep (Wilsmore, 2006).

In the current study higher level of prevalence was observed in female (64.2%) animals compared to the level of prevalence observed in male animals (51.1%). Sissay (1996) and Biru (2009) also reported similar result. The difference of prevalence between male and female animals may associated with the fact that resistance to infection is abrogated at the time of parturition and during early lactation which results in the females' inability to expel adult worms (Craig, 1998) and cause higher level of larvae detection.

Higher prevalence (67.2%) was observed in animals of less than or equal to one year of age than the prevalence (56%) observed in animals of greater than one year of age. This might be associated with the apparent inability of the host to develop acquired immunity. Relatively, animals greater than one year of age have more frequent exposure to lungworms than animals less than or equal to one year of age, so that more likely to develop acquired resistance to these specific parasites, hence lower prevalence.

In the present study, different level of prevalences were observed in animals which have poor body condition (76.8%), medium body condition (51.8%) and in animals of good body condition (48.5%). The reason for this could be due to the fact that poorly nourished animals appear to be less competent in getting ride off infection although it is not unusual for well fed animals to succumb to the disease provided the right environmental conditions are made available (Kimberling, 1988).

Higher infection prevalence (71.4%) was observed in animals showing respiratory symptoms compared to the prevalence (52.7%) in animals which were apparently healthy. It was in agreement with the work of Alemu (2006) who reported higher prevalence of lungworm infection (75.3%) in animals showing clinical sign. The highest level of infrection prevalence of lungworms (68.8%) was observed in December unlike other previous studies Ayalew (1973) and

Thomson and Orita (1988), who report higher level of prevalence at the end of rainy season and remarkable decline when the dry season increases.This disparity might be associated with the number of samples examined; in the current study, larger number of animals was examined in December which might cause for the higher prevalence.

The prevalence of lungworm infection obtained by postmortem examination was higher (63.1%) than the result obtained by coproscopic examination (59.9%). This finding is consistent with that of Durant (1960) and Alemu *et al*. (2006). One of the probable reasons attributed for such differences could be due to the stage of parasites. In the prepatent or postpatent phases or during hypobiosis, it is impossible to detect these parasites by faecal examination (Fraser, 1992). It is also impossible to detect male parasites that might have significant pathogenic role by Coproscopic examination if they are the dominant parasites infecting the animal. Furthermore, egg laying may be inhibited by the immune reaction of the host but clinical signs appear as a slight infection (Hansen, 1994).

In the study of the identified species of lungworms of small ruminants both by fecal and postmortem examination, *D. filaria* was isolated more frequently both by faecal and postmortem examinations followed by *P. rufescens* while *M. capillaris* was the least identified. This difference in the prevalence of the different species of lungworms may be associated with the differences in the life cycles. *Dictyocaulu filaria* has a direct lifecycle; takes less time to reach the infective stage and the larvae can appear in the faeces with in five weeks after ingestion (Soulsby, 1982). The transmission of *P. rufescens* and *M. capillaris* is complex involving host, parasite, intermediate host and climate. Furthermore development from first stage to infective stage larvae in the snail takes 12 to 14 days and the prepatent period can take 30 to 60 days. Therefore, the probability of infection, transmission and reinfection takes longer time compared with *D. filaria* and causes for the low frequency of infection in these parasites (Urquhart *et al.,* 1994).

4. CONCLUSION

In this cross-sectional study of lungworms in small ruminants, prevalence of 59.9% and 63.1% was observed by fecal and postmortem examinations respectively. Different risk factors are found affecting the prevalence; of the two species, goats were more susceptible to lungworms. Higher levels of prevalence recorded in female animals, in animals less than one year of age, in animals which had poor body condition, and in animals which had

respiratory symptom. *Dictyocaulus filaria*, *M. capillaris* and *P. rufescens* were identified. *Dictyocaulus filaria* was detected more frequently followed by *P. rufescens.* Higher level of prevalence was observed by the postmortem examination than the prevalence detected by coprological examination. There is high prevalence of lungworm infection in the study area, therefore every concerned individual should think for the proper control and prevention of lungworms like application of repeat deworming.

References

Alemu, S., Esayas, G. L., Gelagy, A. and Aschalew, Z., 2006. Study on small ruminants' lungworm in north east Ethiopia. *Egyptian journal Veterinary Parasitology*, 14 (2), p. 330-335

Anne M, Zajac, and Gray, A. Conboy., 2006. *Veterinary clinical parasitology* .7th ed. Australia: Black well publishing, P. 12-16.

APEDO (Arsi plan and economic development office), 2008. Socio-economic on Arsi Zone, Assela, Arsi. p. 20-30.

Ayalew, I., Fechette, J. L., Malo, R. and Beaukkegard G., 1995. Study on the incidence of Dictyocaulus filaria in sheep of Ramoski region Can. *Veterinary Journal.* 14 (12), p. 305-310

Biru, T., 2009. Prevalence of lungworm infection of small ruminants in north and south Gondar zones. DVM Thesis, University of Gondar, Faculty of Veterinary Medicine, Gondar, Ethiopia, p. 8-12.

Cooper, M. and Thormas, R.J., 1985. *The profitable sheep farming* .5th ed. Farming Run Ltd, p. 56.

Craig, T. M., 1998. Epidemiology of internal parasites, Effect of climate and host on reproductive cycle on parasite survival. *In: Small Ruminant for the Mixed Animal Practitioner, Western Veterinary Conference, Las Vegas, Nevada*.

Desalegn, L., 1999. *Proceeding of the 13th conference of Ethiopian Veterinay Association*. p. 1035-1040.

Dunn, A. M., 1978. Veterinary helimenthology. 2nd ed. London: William Heinemann Medicine books LTD, p. 203-204.

Durant, A. J., 1960. Lungworms in dairy goats. *Dairy Goats Journal.* 38 (2), p. 8–10.

FAO., 1983. International scheme for the coordination of dairy development and international meat develop met schemes. *Report of a mission to Ethiopia, 27 May -28 June 1989 working paper*, 2312, Bome,Itally.

Fraser, C. M., 1991. The Merck Veterinary Manual: A handbook of diagnosis therapy and disease prevention and control for the veterinarians. 7th ed. USA: Marck and Co., inc., Rahway, Nit, p. 620-621.

Getachew, T., 1995. Parasites of small ruminants. In: Gray, G. D. and Vilenberg, G. (ed). Parasitological Research in Africa. 52, p. 199-205.

Hansen, J., 1994. *The epidemiology, diagnosis and control of Helminthes parasites of ruminants*. Kenya: ILRAD, Nairobi, p. 38-40.

ILCA (International livestock center for Africa)., 1991. *Proceeding of research planning work shop on resistant to endoparasites in small ruminants.* Addis Ababa, Ethiopia, 5-7 February 1991. ILCA, Addis Ababa.

Kassai, T., 1999. *Veterinary helminthological. Butter worth helminthology*. Hungary: Budapest, p. 85-96.

Kimberling, C.V., 1988. Diseases of sheep. 3rd ed. Lea and Febiger: Philadelphia, p. 29–31.

PFE (Pastoralist Forum Ethiopia), 2004. Back ground to the Ethiopian livestock industry. *In Proceeding* 3rd *National Conference on Pastoral Development in Ethiopia: Pastoralism and sustainable pastoral development, 23-24 December, Addis Ababa*. PFE, Addis Ababa, p. 78-79.

Paulos, A., 2000. Importance of seasonal dynamics of lungworm infection of small ruminants in Chilalo, Arsi zone. DVM Thesis, Addis Ababa University, Faculty of Veterinary Medicine, Debre Zeit, Ethiopia, p. 15-18.

Radositis, O. M., Gay, C., Blood, D. C. and Hinchclift, K. W., 2007. Disease associated with helminthes parasite. In: Veterinary Medicine: A Text Book of the diseases of cattle, sheep, goats, pigs and horses. 9th ed. London: Harcourt publishers' Ltd, p. 1564-1569.

Radositis, O. M., Gay, C., Blood, D. C. and Hinchclift, K. W., 2000. Disease associated with helminthes parasite. In: Veterinary Medicine: A text book of the diseases of cattle, sheep, goats, pigs and horses. 9th ed. London: Harcourt publishers' Ltd, p. 1653-1655.

Radositis, O. M., Gay, C., Blood, D. C. and Gay, C., 1994. *Veterinary Medicine: A Text Book of the disease of cattle, sheep, goats, pigs and horses*. 8th ed. London: Baillie Tindal.

Schinder, T., 2000. Helminthes of respiratory system. *In: Veterinary Medicine Parasitology*. Vol-5, Voll standing auflage. Berlin: Parey buch vet log, P. 193-198.

Sissay, A., 1996. *Preliminary study on the prevalence of ovine lungworm infection in and around Bahir Dar*. DVM Thesis. Addis Ababa University, Faculty of Veterinary Medicine, Debre Zeit, Ethiopia.

Solusby, E. J. L., 1986. *Helminthes, Arthropods and Protozoa of domesticated animals.* 7th ed. London: Baillière tindall, p. 262-264.

Steele, M., 1996. *Goats. In: The tropical agriculturalists, London and basing stock.* ACCT, MACLUAN education Ltd, p. 79-83.

Tefera, S.,1983. *Prevalence of lungworm infection around Dessie and Kombolcha*. DVM Thesis, Addis Ababa University, Faculty of Veterinary Medicine, Debre zeit, Ethiopia.

Teshale, S., Muhie, Y., Dagne, A., and Kidanemariam, A., 2006. Seroprevalence of small ruminant brucellosis in selected districts of Afar and Somali pastoral areas of Eastern Ethiopia: the impact of husbandry practice. *Revue Medical. Veterinary*, 157(11), p. 557-563.

Thomson, E. F. and Orita, G., 1988. Seasonal prevalence of protostrongylid and *Dictyocaulus* species of lungworms in Awassi sheep in North-west Syria. *Tropical Animals Health Production.* 20(5), p. 187–189.

Thrusfield, M., 1995. *Deparetement of Veterinary Clinical studies Royal (disk) School of Veterinary studies*. 2nd ed. London: University of Edplug.

TWRAD (Tiyo Woreda Rural and Agricultural Development)., 2008. *Basic data of Tiyo district*.

Tsegaye, S., 1985. *Prevalence of Dictiyocaulus filaria in Giant Awraja.* DVM Thesis, Addis Ababa University, Faculty of Veterinary Medicine, Debre Zeit, Ethiopia.

Uqbazghi, K., 9910. *Preliminary study on the prevalence of lungworm in small ruminants in Hamasien Awarwja*. DVM Thesis, Addis Ababa University, Faculty of Veterinary Medicine, Debre Zeit, Ethiopia.

Urquhart, H. M., Armour, J., Duncan, J. L., Dunn, A. M. and Jennings, F. W., 1996. *Veterinary Parasitology*. 2nd ed. London: Blackwell Science Ltd, P. 304-309.

Urquhart, G. M., Armour, J., Duncan, J. L. and Jenning, F. W., 1994. *Veterinary Parasitology*. Longman English language Society, p. 39–58.

Wilsmore, T., 2006. *Diseases of small ruminants' in Ethiopia*. The veterinary epidemiology and economics research unit (Bieeru) school of agriculture's policy and development in the University of Read, UK, p .6, 7 and 72.